of our civilisation is evaluated into simple terms by means of proved psychological conclusions.

But the whole social organism is one, and the influence of the school is only one factor; whether with rich or with poor, the home and the "street" have a majority influence.

The subject is all-important for the future of a race, but the intrinsic character of the race always supervenes unless and until acquired characters become transmissible.

A. E. CRAWLEY.

LETTERS TO THE EDITOR.

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The Organisation of Science.

SIR WILLIAM CROOKES hit the nail on the head when he said that the nation's attitude towards science is "largely due to the popular idea that science is a kind of hobby" (NATURE, December 2, 1915); and "F.R.S." directed the point of it when he said:—"What else can the general public do while men of science, in dealing with one another, generally act upon the principle that scientific investigation is a hobby for which facilities are required, not payment?" (NATURE, December 23, 1915). There is in this a distinct dereliction of duty, both by the public and by men of science. Science is not an amusement, but the most important of industries; and it is a premier obligation, of the public, of Government, and of men of science themselves, to advance it by every means in their power. Now what is the truth? Of all the occupations which individual men can possibly follow, the serious investigation of nature is the most profitable to the world at large—and the least profitable to the person who undertakes it. The result, controlled by ordinary economic laws, is that very few persons indeed ever do really engage in it, and if they do they suffer in consequence.

There is, of course, much scientific dabbling being done—precisely as a hobby; but as I take it, what may be called high science has for its end not the mere recording of isolated observations, of plausible speculations, and of interesting curiosities, but the solution of difficult problems. Petty science is one thing; high science is another. Petty science is often extremely useful, and even occasionally leads to discoveries of the first importance; but the general advancement of our knowledge of nature depends upon the indefatigable, the laborious, and often the unavailing, search for solutions. It is precisely this last and greatest kind of effort which the hobby idea renders almost impossible—except perhaps for a few comparatively wealthy persons.

Consider, for example, the case of the dysentery problem. One form of this disease was found more than thirty years ago to be caused by certain amœbæ. Since then innumerable petty papers have been written on this subject, giving the results of a few weeks' or months' work, scattered observations, brilliant speculations, and beautiful coloured pictures. But even to-day we do not know how these organisms enter our bodies, and many questions which are fundamental as regards both treatment and prevention remain unanswered. The result is that thousands if not hundreds of thousands of persons die annually from a most painful disease; that our armies suffer in the field; and that the taxpayer is forced to expend large sums of money, a tithe of which would probably have solved the problem if it had been expended on proper research. But certain bodies which disburse small doles for so-called scientific research will hold up their hands in horror, and will say, "We have given such-and-such sums; we have paid so-and-so's salary; we have provided laboratories and microscopes here and there." So they have; but the result has been almost nil, because no individual man capable of solving the difficult problem has set his intellect to the task. Supposing that such a man exists, why should he set himself to the task? Should he give up his medical practice, or his professorship, or his leisure, to undertake a difficult inquiry which might prove fruitless in the end, just because a Government grant will provide him with apparatus and possibly a laboratory assistant? Personally, I think that such a man would not be likely to possess the capacity to solve any problem.

We may acknowledge with thanks that the nation does appear to be wakening to the necessity for assisting science; but it has not yet awakened to the fundamental issue—namely, that it must pay for work actually done—for results actually achieved—and not only for the expenses of research students and of professors who wish to indulge their "hobbies." This is the proper and most economical way to encourage science. For example, suppose that some person has solved, after years of toil, the dysentery problem, what would he receive for it? He would almost certainly lose his medical practice (as Edward Jenner did), much of his work would be pirated, he would be hampered at every turn by jealousies, and the only reward which he would be likely to receive might be a knighthood (which is the gift of the King and not of the country).

Men of science are themselves mostly to blame for this state of things. They show no solid front and have no courage in enforcing their demands. Besides this, there are many of them who actually make a cult of pretending that scientific work should be gratuitous. They are themselves too noble to accept payment; but I observe that few of these gentlemen have ever done important scientific work, but that, on the other hand, they are always first in the field when lucrative appointments are going. Indeed, quite a profession has grown up—that of persuading other men to do gratuitous scientific work for Government departments and for the public; and our grateful Governments respond at once by giving these people honours and lucrative posts, which they too often withhold from the men who have actually done the investigations.

Our learned societies are not less to blame Although they profess to encourage science in every way, they do nothing, or almost nothing, for the workers. What efforts have they made to remedy the innumerable abuses now existing in connection with science—the wretched salaries without pensions, the uncertain tenure of office, the misappropriation of appointments, the piracies, the farming out of scientific men by certain institutions for their own profit, and a dozen others? Indeed many of these societies do themselves lead the way in perpetuating such abuses. One of their grossest faults is to obtain gratuitous scientific work from their members for the advantage of Government departments and private institutions—thus, to speak plainly, acting as touts for the departments referred to, and at the same time depriving their expert members of the emoluments which they should receive for

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their work or advice. What wonder, then, that the public, which sees through this kind of thing, should tend to despise, not only scientific men, but science itself?

It is idle to disguise the fact that recent events have filled most educated persons with a sense of extreme resentment against the administration of this country—a resentment which I have heard expressed by numbers of persons—civilians and soldiers. It is felt by many (and I am one of them) that we live under the rule of the invertebrates. The people who administer the country are not the best, the most vigorous, and the most sagacious of men. They are too often the time-servers and the mediocrities. The maladministration of scientific affairs is only one of the many forms of maladministration; but, on the whole, I think it is perhaps the most important form, because it gives to the mind of the whole nation a lower, a meaner, and a thoroughly sentimental and unpractical turn. For more than half a century before the war England has ceased to be an intellectual nation; the public at large has remained indifferent to science, art, literature, invention, and all the great intellectual pursuits, and has given itself up to game-playing, party politics, faddism, and a debased drama. We are now paying the penalty, and, if I do not mistake, will have to pay a heavier one before the end. If we have produced great men their names are unknown to the multitude, while the wire-pullers, the sentimentalists, and the hypocrites sit on high. That is my own summing up of the British nation of to-day—and I know that many agree with me. I am also of opinion that when our soldiers return from this war there will be something very like a revolution against the class of men who at present misgovern us in almost everything.

Sir William Crookes suggests a Ministry of Science and representation of science on the Privy Council. But in the light of our present experience are these likely to help us in any way? The Board of Education was appointed partly for this purpose, and what does it do for the worker? It has formulated a contributory pension scheme, but I believe nothing else. The able editorials in NATURE of November 24 and December 2, 1915, well define the position of science in this country to-day; but no reform is likely to be effected so long as men of science themselves do not insist upon it. What is required is a small association of strong men banded together for the express purpose of forcing the pace without fear or favour, and in spite of twaddlers who now paralyse all efforts at improvement. I would suggest at once the following programme:—

(1) Direct payment by the State for non-remunerative scientific work which has been of benefit to the public at large.

(2) Invariable payment by Government departments and public bodies for all scientific expert advice or assistance whatever.

(3) No issue of Government grants for expenses of researches without a fixed payment of, say, 50 per cent. to the workers themselves for their expenditure of time on the work.

(4) Control by the State over the sweating system now employed by universities and numerous public bodies in connection with scientific workers of all kinds.

Sir William Crookes thinks that our national attitude towards science "can only be rectified slowly, step by step." But war is a rapid arbiter, and the sword does not wait for the armour to be girded on. If I mistake not, we have not much time left for repentance.

RONALD ROSS.

January 3.

Germany's Supplies of Nitric Acid.

AN article in the *Times* of January 6 deals with the resources in Germany for producing nitric acid. Formerly, the major part of the world's supply of nitrates came from the *caliche* beds on the west of the Andes, but of recent years, as is well known, nitric acid and nitrates have been manufactured by the electric process of Birkeland and Eyde in various parts of Norway. Franck and Caro, some years ago, introduced a process whereby ammonia can be produced from calcium carbide, after conversion into calcium cyanamide. The Ostwald-Kaiser process of partially oxidising ammonia by passing it along with air over platinum or other contact substances, afforded a practical means of producing cheap nitric acid. Then the discovery of Haber and Le Rossignol, that nitrogen and hydrogen could be combined in presence of contact agents under high pressure, and at moderate temperatures, made it possible to synthesise ammonia more cheaply than it could be obtained by recovery from gasworks liquors.

It is understood that the German Government subsidised the Badische factory to the extent of 100 million marks at the beginning of the war, so that no shortage in their supplies should occur. They claim to be producing sulphate of ammonium, according to Mr. D. Milne Watson, at the rate of 300,000 tons a year, and it is not impossible, provided they can get sufficient sulphuric acid. Mr. A. E. Barton, who has just returned from a visit to Norway and Sweden, learned that the increase in the Badische Company's output of ammonium sulphate was 200,000 tons; they had formerly manufactured 150,000 tons a year. Plant of 10,000 h.p. is being erected, too, in Westphalia, to produce ammonia by the carbide process; the result is expected to be the production of 200,000 tons of concentrated nitric acid a year. Other two works, one in Bavaria, and the other near Cologne, produce between them 45,000 tons of cyanamide.

Had our Government taken the steps which were urged upon them in August, 1914, to prevent Chile saltpetre from entering Germany, in all probability there would have been a shortage of nitric acid in Germany. That shortage is now not likely to occur.

W. R.

National Technical Training.

WITH reference to the recent leading articles dealing with the position of science and industry in this country, attention may usefully be directed to the system under which the work of the smaller technical schools is conducted.

At present it is generally admitted that our workpeople are not very scientific, and their trades unions do not appear to realise how much might be done if the various industries had colleges of their own. The only chance a workman has therefore of learning the technical portion of his business is by attending evening classes at the smaller technical colleges, and it is with these schools I would like to deal, since the subject is now of considerable importance.

At most of these places so many subjects are taught that they resemble museums of applied education more than anything else, and the principals in charge of them, and the inspectors who frequently inspect them, have generally no knowledge of *technical* work, or *business* experience. Why there are so many inspectors nobody knows, or what becomes of their reports. Further, the old system of examination has been given up, and "student hours" are made such a fetish, that I have seen classes opened and closed as many as seven times during a session; closed when one

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